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Hugh Smith Lake Sockeye Salmon Studies, 2010

by

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and

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July 2011

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$log_{2,}$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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HUGH SMITH LAKE SOCKEYE SALMON STUDIES, 2010

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

In 2010, we continued long-term population studies at Hugh Smith Lake designed to evaluate adult sockeye salmon abundance and juvenile production. A smolt weir was operated at the outlet of the lake by a separate coho salmon coded-wire tagging project from 19 April to 5 June, during which time an estimated 64,000 sockeye salmon smolt passed through the weir. We estimated that 79% of the emigrating sockeye salmon smolt were freshwater age 2 and 19% were freshwater age 1. From 16 June to 8 November we enumerated the adult salmon escapement through a weir, conducted a secondary mark-recapture estimate to confirm the weir count, and collected biological information to estimate the age, length, and sex composition of the sockeye salmon returning to Hugh Smith Lake. The 2010 weir count of 15,646 adult sockeye salmon was the seventh escapement in the past eight years to meet the optimal escapement goal range of 8,000–18,000 adult sockeye salmon. Age-1.3 fish represented approximately 51% of a spawning population composed of 63% 3-ocean and 37% 2-ocean fish. Peak foot survey counts in the two primary spawning tributaries were 2,025 fish in Buschmann Creek on 14 September and 377 fish in Cobb Creek on 12 September 2010. No area closures or time restrictions were implemented in nearby commercial fisheries as projected returns of Hugh Smith Lake sockeye salmon were above the lower threshold of the escapement goal throughout the season.

Key words: escapement, optimal escapement goal, Hugh Smith Lake, lake stocking, mark-recapture, sockeye salmon, *Oncorhynchus nerka*, stock of concern.

INTRODUCTION

Hugh Smith Lake has been an important sockeye salmon (*Oncorhynchus nerka*) contributor to the commercial net fisheries in Southern Southeast Alaska for over a century. In the late 1800s and early 1900s, intense fishing pressure supplied two canneries in Boca de Quadra and a saltery adjacent to the estuary of Hugh Smith Lake (Rich and Ball 1933, Roppel 1982). Pre-statehood sockeye salmon catch records from Boca de Quadra inlet ranged from 42,000 to 210,000 fish from 1895 to 1912 (Rich and Ball 1933); however, it is not clear what portion of those harvests came from the waters around the entrance of Boca de Quadra. Tagging studies have shown that sockeye salmon migrating through the waters surrounding Boca de Quadra are from highly mixed stocks (Hoffman et al. 1983 and 1984). The sockeye salmon harvest in Boca de Quadra inlet declined sharply after 1912, and from 1918 to 1927 the catch averaged less than 10,000 fish (Rich and Ball 1933). Rich and Ball (1933) suggested that this decline in catches may have been partially due to the closing of all waters within 500 yards of the mouth of Sockeye Creek, the outlet stream of Hugh Smith Lake, in 1916. A private hatchery was operated at the head of Hugh Smith Lake from 1901 to 1903, and from 1908 to 1935, but numbers of adult sockeye salmon returning to the lake were not recorded (Roppel 1982). Egg take numbers during this time suggest that 3,000 to 6,000 females were taken for hatchery use on an annual basis from Buschmann Creek, one of the primary spawning tributaries of Hugh Smith Lake (Roppel 1982). Moser (1898) suggested that despite overfishing, Hugh Smith Lake should produce annual returns of 50,000 sockeye salmon under average conditions.

The Alaska Department of Fish and Game (ADF&G) maintained a weir at the outlet of the Hugh Smith Lake from 1967 to 1971, and annually since 1980. The lake was the subject of ADF&G enhancement efforts beginning in the early 1980s, including nutrient enrichment from 1981 to 1984 and fry plants from 1986 to 1997 (Geiger et al. 2003). The vast majority of juveniles from these early stocking programs were not marked so detailed information on the proportions of stocked and wild fish in subsequent escapements is unavailable. Total escapements declined from an average of 17,500 fish in the 1980s, to 12,000 in the 1990s, and 3,500 fish from 1998 to 2002, including the lowest recorded escapement of 1,138 fish in 1998.

In 2003, the Alaska Board of Fisheries classified Hugh Smith Lake sockeye salmon as a stock of management concern (5 AAC 39.222) due to the long-term decline in escapement (Geiger et al. 2003). The board adopted an action plan to rebuild the sockeye salmon run to levels that would meet the escapement goal range of 8,000–18,000 adult sockeye salmon (*Hugh Smith Lake Sockeye Salmon Action Plan, Final Report to the Board of Fish, RC-106, February 2003*). The escapement goal is an *optimal* escapement goal that includes spawning salmon of wild and hatchery origin (5 AAC 33.390). The action plan directed ADF&G to review stock assessment and rehabilitation efforts at the lake and contained measures to reduce commercial harvests of Hugh Smith Lake sockeye salmon when the escapement was projected to be below the lower end of the escapement goal range. Fishery restrictions, in the form of time and area closures, affected the District 101-11 drift gillnet fishery and the District 101-23 purse seine fishery near the entrance to Boca de Quadra (Figure 1). The rehabilitation effort included an existing hatchery stocking program for which eggs were collected from Buschmann Creek, one of the primary spawning tributaries for sockeye salmon in Hugh Smith Lake, and hatched at Southern Southeast Regional Aquaculture Association's (SSRAA) Burnett Inlet hatchery. Fry were transported back to Hugh Smith Lake where they were held in net pens and fed to pre-smolt size from late May through July. This stocking program occurred from 1999 to 2003 and all released fish were thermal otolith marked. The last adults from this stocking program returned to the lake as 3-ocean adults in 2007.

Total escapements of adult sockeye salmon at Hugh Smith Lake have steadily improved since reaching a low of 1,138 in 1998 (Appendix B) and escapements surpassed the upper end of the escapement goal range from 2003 to 2007 (Piston 2008). Although large numbers of fish were passed through the counting weir in those years, the behavior and distribution of the stocked portion of the run within the system indicated that many of those fish did not fully contribute to juvenile production (Geiger et al. 2005, Piston et al. 2007, Piston 2008 and 2009). From 2003 to 2007, stocked fish made up a significant portion of the escapement at the two primary tributaries of Hugh Smith Lake: an average of 22% at Buschmann Creek and 68% at Cobb Creek, with an additional large, but unknown number of stocked sockeye salmon that attempted to spawn in unsuitable habitat at the outlet of the lake (Piston et al. 2007, Piston 2008). Spring smolt counts from 2005 to 2009 showed no sign of increase over the preceding three years despite a significant increase in brood year escapements since 2003 (Piston and Brunette 2010).

Estimates for the wild portion of the spawning escapement have also improved in recent years. From 2005 to 2007, the escapements of wild sockeye salmon reached the escapement goal for the first time since 1997 (Piston et al. 2007). Due to the positive trend in total escapement through 2005, Hugh Smith Lake sockeye salmon were de-listed as a stock of management concern at the 2006 Board of Fisheries meeting. In 2008, the first year in over two decades that the total escapement was composed entirely of wild fish, only 3,500 adults returned to Hugh Smith Lake to spawn, less than half of the lower bound of the escapement goal range (Appendix B). The poor escapement in 2008 appeared to be associated with conditions that affected salmon runs region-wide, as sockeye salmon escapements to Southeast Alaska were extremely poor in that year and the region-wide harvest of sockeye salmon was the lowest since Alaska statehood (Eggers et al. 2008). Sockeye salmon escapements improved throughout Southeast Alaska in 2009 and at Hugh Smith Lake the escapement goal was again met entirely with wild sockeye salmon (Piston and Brunette 2010).

From 2004 to 2007, ADF&G conducted studies to identify factors that might limit sockeye salmon survival at various stages of their life history. Total juvenile sockeye salmon production, mid-summer-to-spring survival rates of sockeye salmon fry, fry emigration timing from Buschmann and Cobb creeks, habitat changes within Buschmann Creek, and zooplankton production within the lake were examined (Piston et al. 2006 and 2007). A Dolly Varden predation study was also conducted at the spring smolt weir in 2007 (Piston 2008). These studies did not identify any factors in the freshwater environment that would result in reduced juvenile sockeye salmon survival rates.

In 2010, we continued operations at the Hugh Smith Lake adult salmon counting weir. As in previous years, we enumerated the adult escapement by species and conducted a secondary mark-recapture study on sockeye salmon as a backup escapement estimate in the event of a weir failure. Age, sex, and length information was collected from a sub-set of sockeye salmon and bi-weekly foot surveys were conducted on the two primary inlet streams to count spawning salmon in conjunction with mark-recapture efforts. Sockeye salmon smolt numbers were estimated at the spring smolt weir, which was operated by a separate coho salmon (*O. kisutch*) coded-wire tagging project (Shaul et al. 2009), and age, sex, and length information was collected from a sub-set of the sockeye salmon smolt.

STUDY SITE

Hugh Smith Lake (55° 06’ N, 134° 40’ W; Orth 1967) is located on mainland Southeast Alaska, 67 km southeast of Ketchikan in Misty Fjords National Monument (Figure 1). The lake is organically stained and covers a surface area of 320 ha. It has a mean depth of 70 m, a maximum depth of 121 m, and a volume of $222.7 \cdot 10^6$ m^3 (Figure 2). Hugh Smith Lake empties into nearby Boca de Quadra inlet via 50-m-long Sockeye Creek (*ADF&G Anadromous Waters Catalog* number 101-30-10750). Sockeye salmon spawn in two inlet streams: Buschmann Creek flows northwest 4 km to the head of the lake (*ADF&G Anadromous Waters Catalog* number 101-30-10750-2006, Beaver Pond Channel 101-30-10750-3003); and Cobb Creek flows north 8 km to the southeast head of the lake (*ADF&G Anadromous Waters Catalog* number 101-30-10750-2004, Figure 2). Cobb Creek has a barrier to anadromous migration approximately 0.8 km upstream from the lake. Hugh Smith Lake is meromictic and a layer of saltwater located below 60 m does not interact with the upper freshwater layer of the lake.

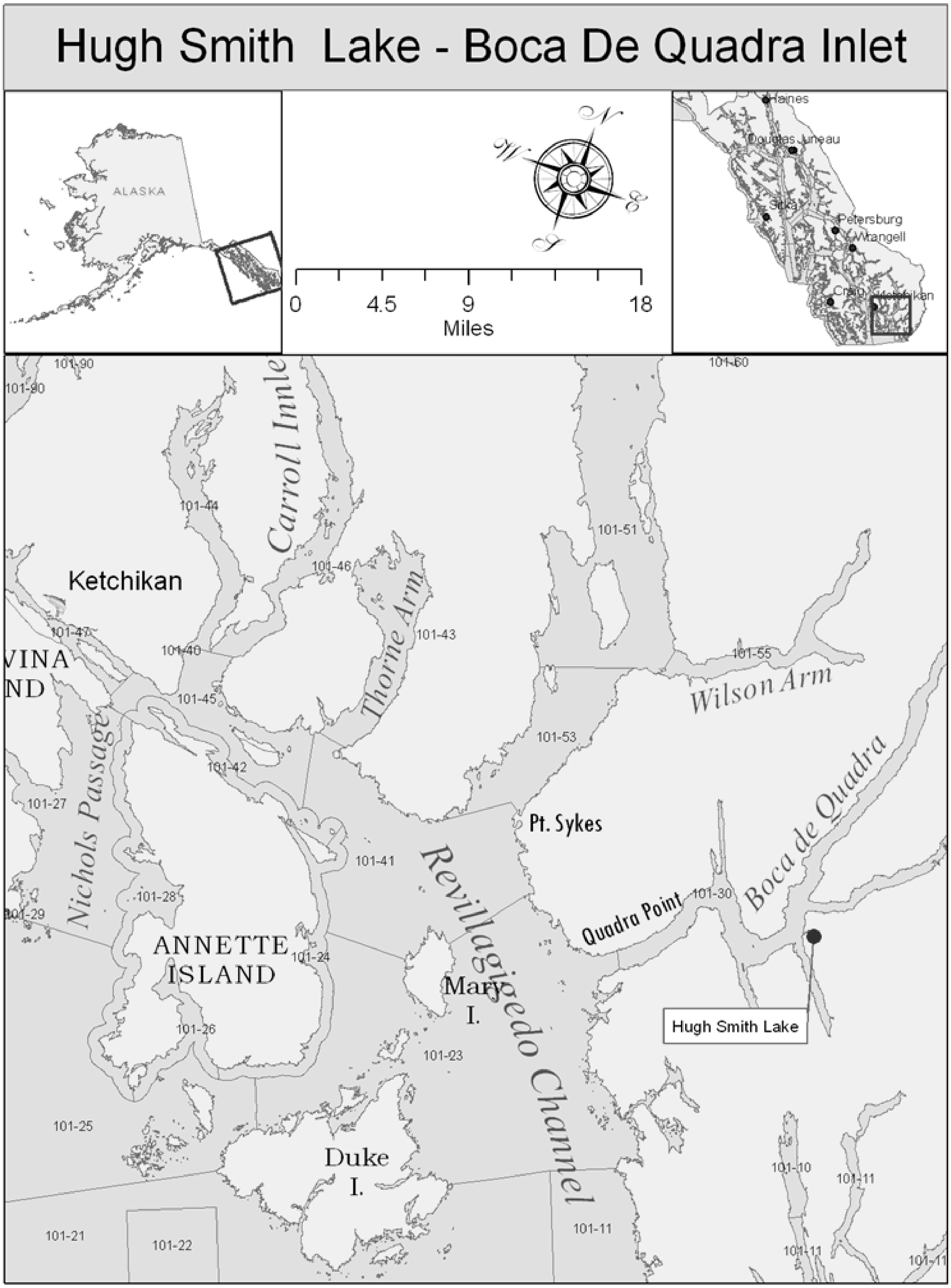

Figure 1.–The location of Hugh Smith Lake in Southeast Alaska.

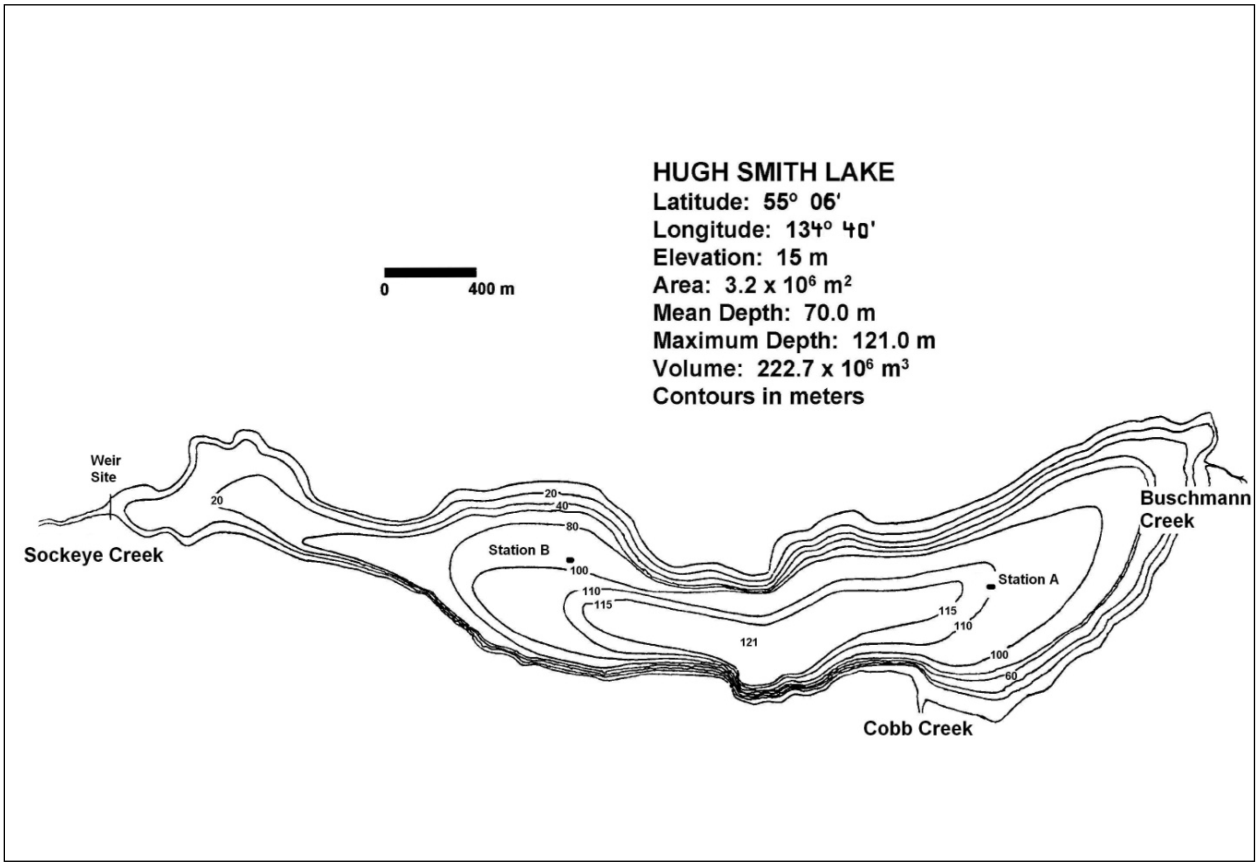

Figure 2.–Bathymetric map of Hugh Smith Lake, Southeast Alaska, showing the location of the weir site, limnology sampling stations A and B, the two primary inlet streams, and other features of the lake system.

METHODS

SMOLT PRODUCTION

Since 1982, coho and sockeye salmon smolt have been sampled and counted through a smolt weir as they emigrate from Hugh Smith Lake each spring (see Shaul et al. 2009 for a physical description of weir). In 2010, the smolt weir was operated from 19 April to 5 June. Fish were counted through the weir by species, and scale samples and length-weight data were collected from sockeye salmon smolt. Sixteen scale samples were collected on days when fewer than 100 fish were captured at the weir, and 28 scale samples were collected on days when greater than 100 fish were captured. The length (snout-to-fork in mm) and weight (to the nearest 0.1 g) were recorded for each fish sampled. A preferred-area scale smear (Clutter and Whitesel 1956) was taken from each fish and mounted on a 2.5 cm × 7.5 cm glass slide, four fish per slide. A video-linked microscope was used to age sockeye salmon smolt scales at the Ketchikan office.

Total smolt weir counts have tended to underestimate the true smolt population size due to fish passing before and after the weir was installed and because fish escaped past the weir uncounted. An unknown but presumably small, number of smolt also pass through a small opening designed to allow free upstream passage of adult steelhead. Hugh Smith Lake coho salmon smolt tagging data from 1982 to 2006 showed that capture rate at the smolt weir was highly variable, ranging from 14% to 84%. In recent years, extra efforts were made to tighten the weir and prevent smolt from passing under or around it uncounted. From 1996 to 2006, these efforts improved the capture efficiency to an average of 70% for coho salmon smolt (Shaul et al. 2009).

ADULT ESCAPEMENT

Weir Counts

ADF&G operated an adult salmon counting weir at the outlet of the lake, approximately 50 m from saltwater, from 1967 to 1971, and from 1981 to 2010. The weir is an aluminum bi-pod, channel-and-picket design, with an upstream trap for enumerating and sampling salmon. The integrity of the weir was verified by periodic underwater inspections and a secondary mark-recapture study. The weir was operated from mid-June to early November in 2010 and fish were counted through the weir in a way that minimized handling as much as possible.

Adjacent to the primary upstream trap, we built a secondary trap/counting station designed to allow for free passage of fish into the lake. The secondary trap was fitted with a drop-closing door which allowed us to immediately block fish passage whenever a coho salmon or other fish of interest entered the secondary trap. Hugh Smith Lake coho salmon are an important indicator stock in Southeast Alaska so it was imperative that all coho salmon were examined for clipped adipose fins and the presence of coded-wire tags before they were passed through the weir (Shaul et al. 2005 and 2009). The secondary trap and drop-closing door allowed us to count sockeye salmon as they passed freely through the counting station while continuing to meet the goals of the ongoing coho salmon study at the lake.

To aid in fish identification, we placed a white board on the streambed at the secondary trap/counting station. We also monitored fish passage with an underwater video camera so that if a coho salmon passed through the weir unexamined, we were still able to identify it as adipose-clipped or unclipped by reviewing the video recording. Additionally, during periods of low water conditions we applied 4–6 mil plastic sheeting to the face of the weir to concentrate the stream flow through the fish passing station and reduce the incidence of fish holding below the weir for extended periods (Piston and Brunette 2010).

Mark-Recapture

As in past years, we conducted a two-sample mark-recapture population study concurrently with weir operations to estimate the total sockeye salmon spawning population at Hugh Smith Lake. These studies helped to determine if fish passed by the weir uncounted or if sockeye salmon entered the lake before the weir was fish tight in mid-June. Adult sockeye salmon (fish >400 mm in length) were marked at a rate of 10% with a readily identifiable fin clip at the weir. Fish that were to be marked were dip-netted from the trap, anesthetized in a clove oil solution (Woolsey et al. 2004), fin-clipped, scale-sampled, and released upstream next to the trap to recover. Fish that did not appear healthy were not marked with a fin-clip. The population of sockeye salmon passing through the weir was stratified through time by applying fin clips on the following schedule: right ventral fin clip from 16 June to 18 July, left ventral fin clip from 19 July to 15 August, and a partial dorsal fin clip from 16 August to 8 November. We did not conduct a mark-recapture study for jack sockeye salmon (<400 mm) because most jacks pass freely through the weir pickets and are not accessible for sampling. In previous years, we have been unable to mark and recover enough fish to obtain a valid population estimate for jack sockeye salmon.

We used Stratified Population Analysis System (SPAS) software[1] (Arnason et al. 1996) to generate mark-recapture estimates of the total spawning population of sockeye salmon. SPAS was designed for analysis of two-sample mark-recapture data where marks and recoveries take place over a number of strata. This program was based on work by Chapman and Junge (1956), Darroch (1961), Seber (1982), and Plante (1990). We used this software to calculate: 1) maximum likelihood (ML) Darroch estimates and pooled-Petersen (Chapman's modified) estimates, and their standard errors; 2) χ^2 tests for goodness-of-fit based on the deviation of predicted values (fitted by the ML Darroch estimate) from the observed values; and 3) two χ^2 tests of the validity of using fully pooled data—a test of complete mixing of marked fish between release and recovery strata, and a test of equal proportions of marked fish in the recovery strata. We chose full pooling of the data (i.e., the pooled-Petersen estimate) if the result of either of these tests was not significant ($P>0.05$). Our goal was to estimate the escapement such that the coefficient of variation was no greater than 15% of the point estimate. The manipulation of release and recovery strata in calculating estimates (the method used in SPAS) was presented and discussed at length by Schwarz and Taylor (1998).

The weir count was deemed "verified" and entered as the official escapement estimate if it fell within the 95% confidence interval of the mark-recapture estimate of adult sockeye salmon. This was the same criterion used in previous years (Geiger et al. 2003). The escapement goal was judged to have been met if the weir count fell within the escapement goal range and within the 95% confidence interval of the mark-recapture estimate for adult sockeye salmon. If both the weir count and the mark-recapture estimate were below the lower bound of the escapement goal range, the escapement goal would be deemed to have not been met. In the case where one or the other estimate fell within the escapement goal range, the weir count would be used, unless the weir count was below the lower bound of the 95% confidence interval of the mark-recapture estimate. Prior to the study we agreed to use the mark-recapture "point" estimate, and not one or the other end of a confidence interval, for the purpose of judging the escapement objective.

Adult Length, Sex, and Scale Sampling

The age composition of adult sockeye salmon at Hugh Smith Lake was determined from a minimum of 600 scale samples collected from live fish at the weir. This sample size was chosen based on work by Thompson (1992) for calculating a sample size to estimate several proportions simultaneously. A sample size of 510 fish was necessary to ensure that the estimated proportions of each of the adult sockeye salmon age classes returning to Hugh Smith Lake would be within 5% of the true value 95% of the time. We increased our sampling goal to 600 scale samples to ensure the sample size target was met even if 15% of the samples were unreadable. We began by taking scale samples from 1 out of every 10 fish (10%). Fish that were less than 400 mm in length (mid eye to tail fork) were classified as jacks and not included in the adult sockeye salmon age composition sample. The sex and length (mid eye to tail fork to the nearest mm) was recorded for each adult fish sampled. Three scales were collected from the preferred area (INPFC 1963), placed on a gum card, and prepared for analysis as described by Clutter and Whitesel (1956). Scale samples were analyzed at the ADF&G salmon-aging laboratory in Douglas, Alaska. The weekly age distribution, the seasonal age distribution weighted by week, and the mean length by age and sex weighted by week were calculated using equations from Cochran (1977; Appendix A).

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[1] Product names used in this publication are included for completeness but do not constitute product endorsement.

Stream Counts

The number of live and dead salmon in the creek was estimated, by species, during each survey of Buschmann and Cobb creeks. Cobb Creek was surveyed from the mouth to the barrier falls (0.42 miles; 55 05.35 N, 130 38.673 W). Buschmann Creek was typically surveyed to the top of the Hatchery Channel on the right fork, and to the beaver ponds on the left fork (Figure 3). We attempted to survey all of Buschmann Creek's stream channels at least twice each week near the peak of the run.

What we have generally referred to as Buschmann Creek actually consists of two separate creeks, draining two separate valleys, which come together in their lower reaches. The stream flowing from the southeast valley is Buschmann Creek (*ADF&G Anadromous Waters Catalog* number 101-30-10750-2006), and the tributary flowing out of the northeast valley that meets Buschmann Creek at what we call the Main Fork is referred to as the Beaver Pond Channel (*ADF&G Anadromous Waters Catalog* number 101-30-10750-3003; Figure 3). The Beaver Pond Channel was named for the one or more beaver dams and ponds along its length.

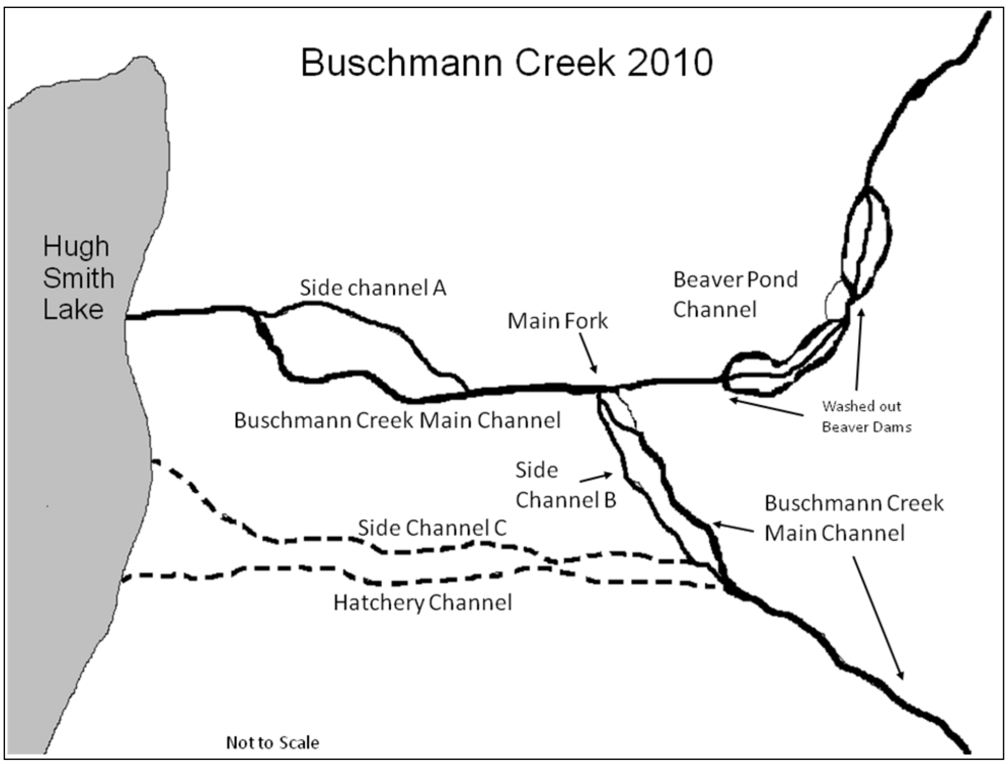

Figure 3.–Schematic diagram of the main channels of lower Buschmann Creek, as of August, 2010. Dashed lines indicate tributaries that were accessible in the past but are now either blocked by beaver dams or did not have adequate water flow to accommodate spawning salmon in 2010.

RESULTS

SMOLT PRODUCTION

An estimated 64,000 sockeye salmon smolt were counted through the smolt weir between 19 April and 5 June (Table 1). Fish began leaving the lake during the third week of April and the crew first passed more than 1,000 sockeye salmon smolt through the weir in a single day on 4 May. Smolt passage peaked during the second and third weeks of May with more than 12,000 sockeye salmon smolt passing the weir on 21 May. Emigration slowed during the first week of June when the smolt weir was removed.

We sampled 1,029 sockeye salmon smolt for scales and determined the freshwater age composition, weighted by week, to be 79% age 2, 19% age 1 and 2% age 3 (Figure 4, Table 1). This is the largest proportion of age-2 smolt since we began collecting annual data on smolt ages in 1981 (Figure 4). The mean lengths of the smolt, by age class, were 80 mm (age 1), 92 mm (age 2), and 110 mm (age 3). The mean weights were 4.5 g (age 1), 6.8 g (age 2), and 11.9 g (age 3, Table 2).

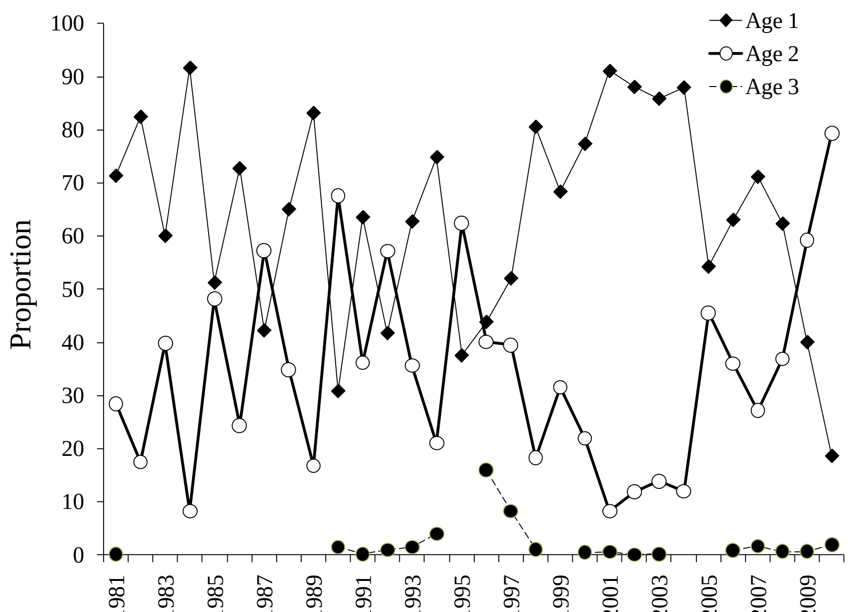

Figure 4.–Age composition of sockeye salmon smolt at Hugh Smith Lake, 1981–2010.

Table 1.–Hugh Smith Lake weir counts of sockeye salmon smolt by smolt year, and stocked fry and pre-smolt releases by year of release, 1981–2010. Proportions of stocked and wild smolt were determined from otolith samples.

Release Year	Hatchery Release Numbers	Release Type	Smolt Year	Total Smolt Counted	Freshwater Age Percent of Total Age 1	Age 2	Age 3	Stocked Smolt Counted	Wild Smolt Counted	Percent Stocked Smolt
			1981	319,000	71%	29%	0%			
			1982	90,000	83%	18%	0%			
			1983	77,000	60%	40%	0%			
			1984	330,000	92%	8%	0%			
			1985	40,000	51%	48%	1%			
			1986	**58,000**[c]	73%	24%	3%			
1986	273,000	Unfed Fry	1987	104,000	42%	57%	1%			
1987	250,000	Unfed Fry	1988	54,000	65%	35%	0%			
1988	1,206,000	Unfed Fry	1989	427,000	83%	17%	0%			
1989	532,800	Unfed Fry	1990	137,000	31%	68%	2%			
1990	1,480,800	Unfed Fry	1991	75,000	64%	36%	0%			
1991			1992	15,000	42%	57%	1%			
1992	477,500	Fed Fry	1993	36,000	63%	36%	2%			
1993			1994	43,000	75%	21%	4%			
1994	645,000	Unfed Fry	1995	19,000	38%	62%	0%			
1995	418,000	Unfed Fry	1996	16,000	44%	40%	16%			
1996	358,000	Unfed Fry/ Pre-Smolt[a]	1997	44,000	52%	40%	8%			
1997	573,000	Unfed Fry	1998	65,000	81%	18%	1%	30,000	34,000	47%
1998			1999	42,000	68%	32%	0%	3,000	39,000	4%
1999	202,000	Pre-smolt[b]	2000	72,000	77%	22%	1%			
2000	380,000	Pre-smolt[b]	2001	190,000	91%	8%	1%	145,000	44,000	77%
2001	445,000	Pre-smolt[b]	2002	297,000	88%	12%	0%	163,000	134,000	55%
2002	465,000	Pre-smolt[b]	2003	261,000	86%	14%	0%	185,000	76,000	71%
2003	420,000	Pre-smolt[b]	2004	364,000	88%	12%	0%	170,000	194,000	47%
2004			2005	77,000	54%	46%	0%		77,000	
2005			2006	119,000	63%	36%	1%		119,000	
2006			2007	89,000	71%	27%	2%		89,000	
2007			2008	59,000	62%	37%	1%		59,000	
2008			2009	116,000	40%	59%	1%		116,000	
2009			2010	64,000	19%	79%	2%		64,000	

[a] In 1996, Southern Southeast Regional Aquaculture Association released 251,123 unfed fry into the lake in May and 106,833 pre-smolt in October. All fish from those releases were otolith marked.

[b] From 1999–2003, fry were pen-reared at the outlet of the lake beginning in late May and released as pre-smolt in late July and early August. All fish from those releases were otolith marked.

[c] The smolt weir count for 1986 that was reported in Geiger et al. (2003), Piston et al. (2006), and Piston et al. (2007) was actually an estimate based on a hydroacoustic survey. A section of the smolt weir was removed from 27–31 May, and researchers at the time probably assumed the hydroacoustic estimate of 373,000 was a better estimate. We judged that this estimate should not be compared directly to other smolt weir estimates and included the smolt weir count for 1986 in this report.

Table 2.–Lengths in millimeters and weights in grams of sockeye salmon smolt at Hugh Smith Lake by age class, weighted by week, 2010. Fewer fish were sampled for weights than for scales and lengths due to a scale malfunction 23–26 April 2010.

	Age Class		
	1	**2**	**3**
Number measured:	212	798	19
Mean Length (mm)	80	92	110
Standard Error (mm)	0.4	0.3	1.2
Maximum Length (mm)	89	77	18.4
Minimum Length (mm)	67	115	10.4
Number weighed:	199	771	19
Mean Weight (g)	4.5	6.8	11.9
Standard Error (g)	0.1	0.1	0.2
Maximum Weight (g)	6.1	12.1	18.4
Minimum Weight (g)	2.8	3.8	10.4

ADULT ESCAPEMENT

Weir and Stream Counts

The adult weir was fish tight from 16 June to 8 November and during that time we passed 15,646 adult sockeye salmon and 158 jacks into the lake (Appendix B). The optimal escapement goal range of 8,000–18,000 sockeye salmon was met exclusively with wild fish for the fifth time in the last six years (Figure 5). The midpoint of the run occurred on 24 July and the 75th percentile occurred on 29 July, nearly a month early (historic mean=22 August, Appendix B). No handling mortalities were observed at the weir in 2010. Peak counts of live sockeye salmon were observed in Buschmann Creek on 14 September (2,025 fish, Table 3) and in Cobb Creek on 12 September (377 fish, Table 4).

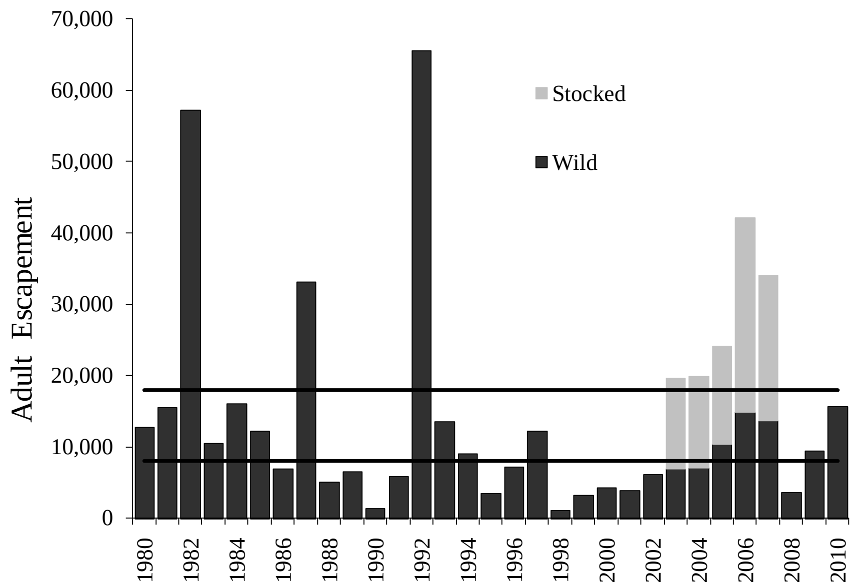

Figure 5.–Annual sockeye salmon escapement at Hugh Smith Lake, 1980–2010. Black horizontal lines indicate the current optimal escapement goal range of 8,000–18,000 adult sockeye salmon which includes both wild and hatchery stocked fish. From 2003 to 2007, the bars are divided to show our estimate of wild (black) and stocked fish (grey) in the escapement. Fry stocked from 1986 to 1997 were thought to have experienced very low survival rates with few surviving to emigrate from the lake (Geiger et al. 2003).

Table 3.–Counts of adult sockeye salmon in Buschmann Creek by stream section, 2010. Blank cells indicate that the section was not surveyed on the corresponding date.

	26-Aug		30-Aug		4-Sep		6-Sep		12-Sep		14-Sep		19-Sep		22-Sep		22-Oct	
	Live	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**
Mouth Estimate			500	0	701	3	1250	3	2000	7	500	3	175	10	375	5	50	0
Main Channel to Fork	415	6	371	13	775	20	956	34	864	130	581	130	287	300	143	80	150	7
Fork to Hatchery Channel			162	5			765	14			849	150	486	250				
Side Channel A	145	2	270	7	335	11	35	6			565	90	185	150				
Side Channel B			0	0			36	3			30	7	8	19				
Beaver Pond Channel					307	4			275	30								
Stream Total	560	8	803	25	1,417	35	1,792	57	1,139	160	2,025	377	966	719	143	80	150	7

Table 4.–Counts of adult sockeye salmon in Cobb Creek, 2010. Each survey was conducted from the mouth to the barrier falls and included all available spawning habitat within the creek.

	31-Aug		7-Sep		12-Sep		17-Sep		22-Sep		22-Oct	
	Live	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**	**Live**	**Dead**
Mouth Estimate			325	0	75	0	23	1	9	0	0	0
Stream Count	114	0	308	2	377	7	326	150	113	270	0	0

Mark-Recapture

A total of 1,565 adult sockeye salmon were marked at the weir over three marking strata: 345 were marked with a right ventral fin clip 18 June–18 July, 1,092 were marked with a left ventral fin clip 19 July–15 August, and 128 were marked with a partial dorsal fin clip 16 August–4 October. Recapture sampling was conducted on the spawning grounds over the course of the entire spawning season from 26 August to 29 October (Table 5). All sockeye salmon carcasses that washed up on the weir were also sampled through 5 November (Table 5). A total of 3,651 fish were sampled for fin clips, of which 339 fish were marked (Table 5). The result of the χ^2 test of complete mixing of marked fish between the marking and recapture events was significant ($P<0.01$); however, the result of the test for equal proportions of marked fish on the spawning grounds was not significant ($P>0.05$), therefore, the pooled-Petersen estimate was used. Our final mark-recapture estimate was 16,824 adult sockeye salmon (SE=768; 95% CI=15,320 to 18,329 fish, Appendix C). The 2010 weir count of 15,646 fish fell within the 95% confidence interval of the mark-recapture estimate so the weir count was used as the official escapement estimate, in accordance with our established methods. The coefficient of variation of 5% satisfied our objective for a coefficient of variation no greater than 15%. The 2010 mark-recapture study did not include jack sockeye salmon because in past years we have been unable to mark and recover enough fish to obtain a reliable population estimate.

Table 5.–Daily number of marked fish recovered by release stratum and total number of carcasses sampled for marks for the adult sockeye salmon mark-recapture study, 2010.

		Number of Marked Fish			Number	Total Number
Date	**Sampling Area**	**Right Ventral**	**Left Ventral**	**Dorsal**	**Unmarked**	**Sampled**
26-Aug	Buschmann Creek	3	1	0	60	64
30-Aug	Buschmann Creek	20	15	0	422	457
4-Sep	Buschmann Creek	5	6	0	93	104
6-Sep	Buschmann Creek	10	17	0	255	282
7-Sep	Cobb Creek	1	5	0	9	15
10-Sep	Buschmann Creek	9	13	0	210	232
12-Sep	Cobb Creek	0	3	0	46	49
12-Sep	Buschmann Creek	11	27	0	370	408
14-Sep	Buschmann Creek	34	25	0	647	706
17-Sep	Cobb Creek	3	14	0	137	154
19-Sep	Buschmann Creek	12	48	1	609	670
22-Sep	Cobb Creek	2	30	0	267	299
22-Sep	Buschmann Creek	4	18	0	165	187
11-Oct	Weir	0	0	0	2	2
13-Oct	Weir	0	0	0	2	2
14-Oct	Weir	0	0	0	2	2
15-Oct	Weir	0	1	0	0	1
18-Oct	Weir	0	0	0	2	2
19-Oct	Weir	0	0	0	2	2
20-Oct	Weir	0	0	0	2	2
22-Oct	Buschmann Creek	0	1	0	7	8
29-Oct	Buschmann Creek	0	0	0	1	1
4-Nov	Weir	0	0	0	1	1
5-Nov	Weir	0	0	0	1	1
	Total	114	224	1	3,312	3,651

Adult Length, Sex, and Scale Sampling

Scale pattern analysis indicated 63% of the sockeye salmon returning to Hugh Smith Lake in 2010 were 3-ocean fish, representing an estimated 9,800 sockeye salmon. The remaining 37% of the spawning escapement was primarily 2-ocean fish, equaling an estimated 5,800 sockeye salmon. More than half of the sockeye salmon escapement (51%) was age-1.3, which is typically the dominant age class at Hugh Smith Lake (Figure 6, Table 6). Of the 942 sockeye salmon sampled at the weir, seven fish had spent three years in freshwater, and one was identified as a 4-ocean fish (Table 6).

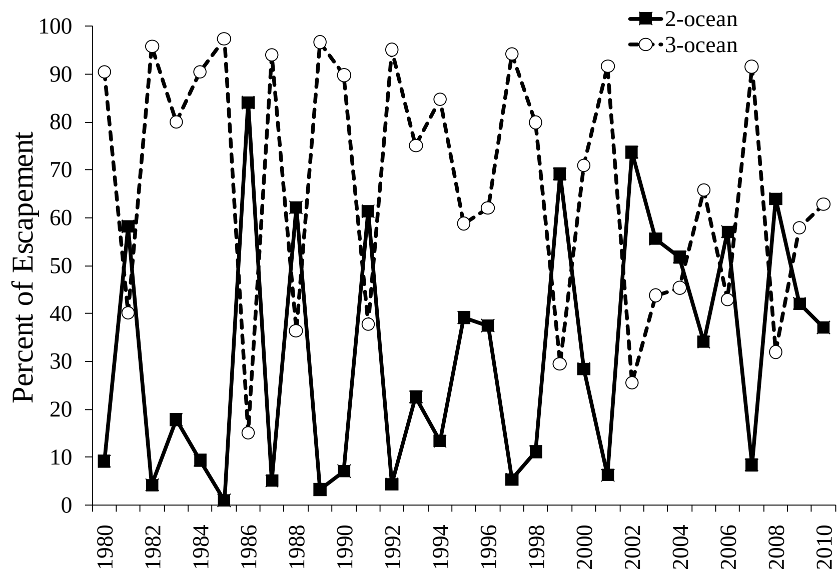

Figure 6.–Annual proportions of age 2-ocean and 3-ocean sockeye salmon in the Hugh Smith Lake escapement, 1980–2010.

Table 6.–Age composition of the 2010 adult sockeye salmon escapement at Hugh Smith Lake based on scale samples, weighted by statistical week.

		Age Class							
Stat Week		1.2	2.2	3.2	1.3	2.3	3.3	1.4	Total
25–26	Sample Size	8	4		27	5			44
	Proportion	18%	9%		61%	11%			
	Esc. Age Class	78	39		264	49			
	SE of %	6%	4%		7%	5%			
27	Sample Size	10	7		57	8		1	83
	Proportion	12%	8%		69%	10%		1%	
	Esc. Age Class	118	82		670	94		12	
	SE of %	3%	3%		5%	3%		1%	
28	Sample Size	22	8		45	8			83
	Proportion	27%	10%		54%	10%			
	Esc. Age Class	252	91		515	91			
	SE of %	5%	3%		5%	3%			
29	Sample Size	20	6		47	14			87
	Proportion	23%	7%		54%	16%			
	Esc. Age Class	219	66		515	154			
	SE of %	4%	3%		5%	4%			
30	Sample Size	79	43	1	219	51	3		396
	Proportion	20%	11%	0%	55%	13%	1%		
	Esc. Age Class	1,358	739	17	3,765	877	52		
	SE of %	2%	2%	0%	2%	2%	0%		
31	Sample Size	12	19		50	9			90
	Proportion	13%	21%		56%	10%			
	Esc. Age Class	249	394		1,036	187			
	SE of %	4%	4%		5%	3%			
32	Sample Size	17	4		20	2			43
	Proportion	40%	9%		47%	5%			
	Esc. Age Class	358	84		421	42			
	SE of %	7%	4%		8%	3%			
33	Sample Size	7	23		23	6	2		61
	Proportion	11%	38%		38%	10%	3%		
	Esc. Age Class	169	555		555	145	48		
	SE of %	4%	6%		6%	4%	2%		
34	Sample Size	1			5	1	1		8
	Proportion	13%			63%	13%	13%		
	Esc. Age Class	20			100	20	20		
	SE of %	12%			18%	12%	12%		
35	Sample Size	5	12		3	1			21
	Proportion	24%	57%		14%	5%			
	Esc. Age Class	134	322		80	27			
	SE of %	9%	11%		8%	5%			
36–41	Sample Size	3	18		3	2			26
	Proportion	12%	69%		12%	8%			
	Esc. Age Class	65	390		65	43			
	SE of %	6%	9%		6%	5%			
Total	Escapement by Age Class	3,020	2,762	17	7,987	1,728	120	12	15,646
	SE of Number	44	53	0	129	18	3	0	
	Proportion by Age Class	19%	18%	0%	51%	11%	1%	0%	
	SE of %	0%	0%	0%	1%	0%	0%	0%	
	Sample Size	184	144	1	499	107	6	1	942

DISCUSSION

The 2010 escapement of 15,646 adult sockeye salmon met the optimal escapement goal for Hugh Smith Lake exclusively with wild fish for the fifth time in the last six years. It was also the largest escapement of wild sockeye salmon since 1992 (Figure 5, Appendix B). The optimal escapement goal, which included fish returning from the stocking program, has now been met in seven out of the last eight years. The only recent escapement below the escapement goal range occurred in 2008, which was an extremely poor year for sockeye salmon throughout Southeast Alaska (Eggers et al. 2008, Piston 2009).

Run timing was early in 2010 and the 75th percentile of the run was reached nearly a month before the historical average date (22 August). Through June and most of July daily weir counts averaged approximately 100 fish per day (maximum, 381 on 17 July). Following a relatively dry week, approximately 5 cm of rain fell at the weir from 22 through 24 July, which raised the water level 25 cm in Sockeye Creek and triggered a large movement of fish into the lake. The crew passed 6,249 sockeye salmon through the weir on 23 and 24 July, nearly 40% of the total escapement. Within a week, both the midpoint and the 75th percentile of the run were reached. The 5,165 sockeye salmon that were passed on 24 July was the largest recorded daily count since 2006.

Operation of the secondary trap and fish passing station allowed us to quickly enumerate the large school of fish that passed through the weir on 23 and 24 July without introducing additional stress from handling or delaying migration timing. Prior to 2003, each fish was manually dipnetted out of the trap and into the lake, a process that could reduce their protective slime layer and cause incidental scale-loss through contact with the net or gloves. Additionally, in years of extremely large escapements, fish were detained behind the weir when the crew was physically unable to pass all fish in a single day, typically during the peak of the run. Those fish were more susceptible to bear predation at night. The secondary trap has reduced the physical demand of passing fish and minimized fish handling; as a result, no stress injuries have been incurred by the crew and only two handling induced fish mortalities have occurred at the weir in the last three years (Appendix B).

Mark-recapture studies provide a secondary population estimate if fish pass through the weir uncounted. On 18 July, the crew observed two sockeye salmon pass through an opening underneath one of the bipods. Sand bags were immediately repositioned to prevent further fish passage; however, it is likely that additional sockeye salmon passed through this opening before the hole was detected. Over the years, stacked rows of sandbags have provided stable, level pads for each of the 10 bipods that support the weir along the uneven stream bed of Sockeye Creek. Additionally, rows of sandbags are placed along the front of the weir to ensure that all of the contact points between pickets and the stream bed are covered. Sandbags may have shifted away from the bipod after the weir was installed, opening an area for fish to pass through uncounted. Daily underwater inspections of the weir allowed us to quickly isolate and remedy this situation; however, the exact number of fish that passed uncounted is unknown.

Although the discrepancy between the weir count and the mark-recapture point estimate was approximately 1,200 fish, the weir count fell within the 95% confidence interval of the mark-recapture estimate and, therefore, we used the weir count as the official escapement estimate for 2010. In most years, the weir count likely under-represents the actual escapement to a small degree due to fish moving into the lake before the weir is installed. In contrast, the mark-recapture point estimate can over or under-represent the actual escapement to an unknown, variable degree each year. For example, in years when the mark-recapture point estimate is less than the weir count, we know that it is a less accurate estimate of the escapement because it under-represents the actual escapement to an even greater degree than the weir count. Since 1992, the mark-recapture point estimate was less than the weir count in six years (Figure 7, Appendix C). We feel weir counts typically offer a more consistent estimate of escapement than mark-recapture estimates, except when the weir count is severely flawed and is below the lower bound of the 95% confidence interval for the mark-recapture point estimate. Mark-recapture estimates were reported in place of weir counts in only four of the last 19 years (Appendix C).

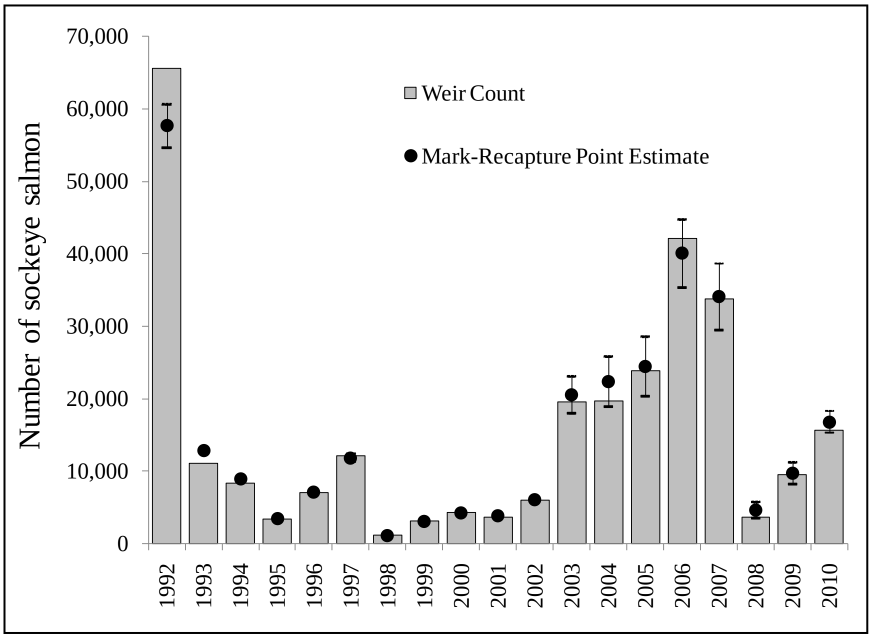

Figure 7.–Annual weir counts and mark-recapture estimates shown with upper and lower bounds of the 95% confidence interval, 1992–2010.

Piston and Brunette (2010) noted that many years of large returns of 2-ocean fish at Hugh Smith Lake were followed by a large return of 3-ocean fish in the subsequent year. The 2010 adult escapement included a large number of 2-ocean fish (5,800). If we only consider years not affected by the most recent stocking program, the number of wild 2-ocean fish in 2010 was the largest for this age class since 1981 (Figure 8). Since 1981, there are now eight years, unaffected by the pre-smolt stocking program with greater than 2,500 2-ocean fish in the escapement (Figure 8). The median number of 3-ocean fish in the escapement following these years was approximately 9,100 fish (range=1,153 in 2008 to 62,514 in 1992). This pattern suggests that there is a strong possibility of seeing a large return of 3-ocean fish in 2011.

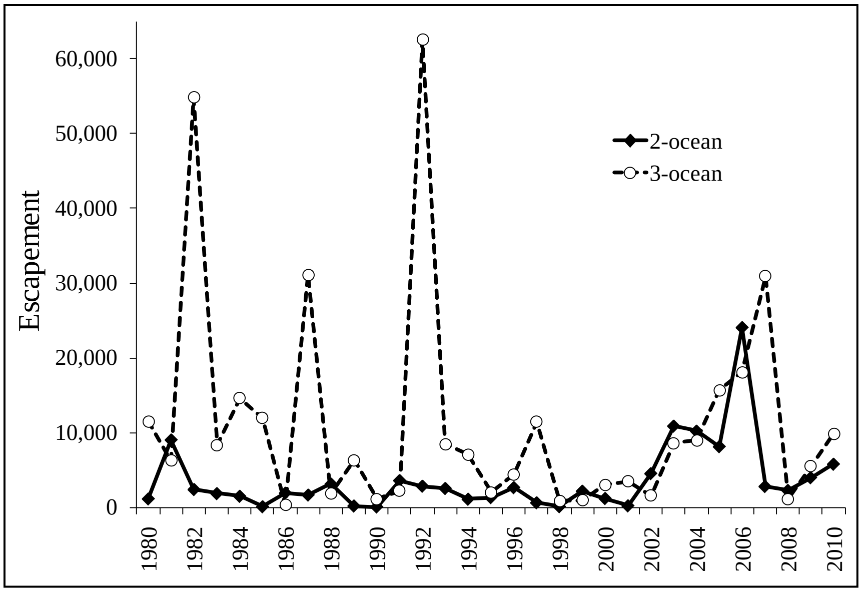

Figure 8.–Annual numbers of 2-ocean and 3-ocean aged sockeye salmon in the Hugh Smith Lake escapement, 1980–2010.

Sockeye salmon mean length-at-age shifts annually in response to environmental variations that promote or hinder salmon growth rates (Burgner 1991). In early July, the crew reported several fish at the weir that were slightly longer than our pre-determined maximum mid eye to tail fork length for jack sockeye salmon (400 mm). We collected length data and scale samples from these fish to determine if our cutoff length for classifying sockeye salmon as either jacks or adults was appropriate for this year's escapement. These fish were age-1.2 adults and not age-1.1 jacks as was initially thought, so changing the minimum size limit for adults was not necessary in 2010. Age-1.2 sockeye salmon in the 400–425 mm size range are not entirely uncommon for Alaska lakes, or even for Hugh Smith Lake (Iris Frank, ADF&G salmon-aging laboratory, Douglas, Alaska, personal communication). The mean length for age-1.2 adults at Hugh Smith Lake has been as low as 465 mm (1994, 1984). Although we have sampled fish in this age class that were less than 400 mm (Figure 9), the average length has been greater than 500 mm for the past 15 years. Since 1982, only 13 of 8,574 age-1.2 adult sockeye salmon sampled at the weir measured less than 400 mm mid eye to tail fork length.

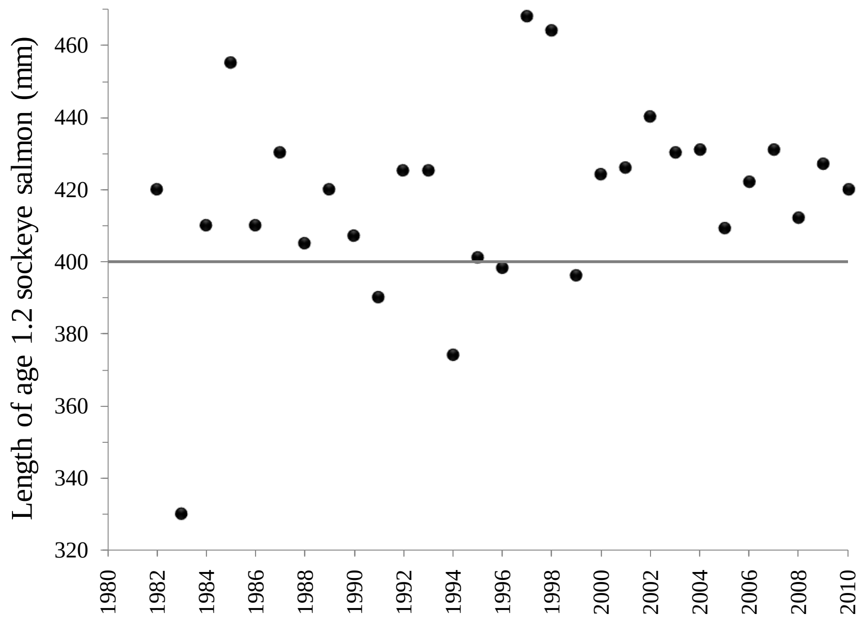

Figure 9.–Minimum mid eye to tail fork length in millimeters of age-1.2 sockeye salmon at Hugh Smith Lake, 1982–2010.

The estimated number of age-1 smolt emigrating from the lake in 2010 was the lowest since 1996 and was likely the result of a poor parent-year escapement of only 3,500 adults in 2008. Though few in number, the average size of age-1 smolt in 2010 (mean length=80 mm, mean weight=4.5 g) was larger than the average size of wild age-1 smolt from 2005 to 2009 (mean length=71 mm, mean weight=3.1 g). Fry that reared in Hugh Smith Lake during the summer of 2009 appear to have experienced conditions conducive to growth, perhaps due to reduced competition for food with fewer fry in the system. The estimated number of age-2 smolt in 2010 (50,400) was the second largest number for this age class since 1990. The prevalence of age-2 smolt may help buffer the low smolt production from the poor 2008 brood year in future adult escapements. In addition, the 2009 escapement of 9,500 adults could yield a strong year-class of age-1 smolt to emigrate concurrently in 2011 with the remaining age-2 smolt from the 2008 brood year. The buffer provided by multiple age-classes could significantly reduce the negative effect the poor 2008 brood year may have on future adult escapements.

While no longer a stock of management concern, ADF&G continued to manage the District 1 drift gillnet and purse seine fisheries in a manner consistent with the Hugh Smith Lake Sockeye Salmon Action Plan (Final Report to the Board of Fish, RC-106, February 2003). In 2010, the high abundance of pink salmon in southern Southeast Alaska shifted a larger portion of the purse seine fleet into District 1. This redistribution of the purse seine fleet increased fishing effort in subdistrict 101-23 to levels not seen since 2001 (Figure 10). Although the amount of fishing time in 2010 remained unchanged from 2009, the number of boats in subdistrict 101-23 increased to an average 14 boats per week (2002–2009 average=5 boats per week). Subsequently, the harvest of sockeye salmon in subdistrict 101-23 in 2010 (12,389 fish) was the largest since 2000 and greater than the combined harvest of the past five years (Figure 10). In the subdistrict 101-11 drift gillnet fishery, effort has increased slightly over the past five years but remained below levels of the 1980s and 1990s (Figure 11). The sockeye salmon harvest in subdistrict 101-11 has been below the long-term average over the past five years (Figure 11). Studies conducted from 2004 to 2007 showed the commercial harvest rate of thermal-marked Hugh Smith Lake sockeye salmon in District 1 ranged from 25% to 66% (average=43%) despite the extremely low fishing effort in those years (Heinl et al. 2007). The highest proportions of marked fish were found in subdistrict 101-23. If inseason escapement projections were below the lower bound of the optimal escapement goal in statistical weeks 29 to 33 (approximately mid-July to mid-August), fishing area near the mouth of Boca de Quadra, in sub-districts 101-11 and 101-23, would have been reduced to allow additional sockeye salmon to pass through the fisheries. No fishing restrictions were necessary in 2010 since inseason escapement projections were above the lower bound of the escapement goal throughout the season.

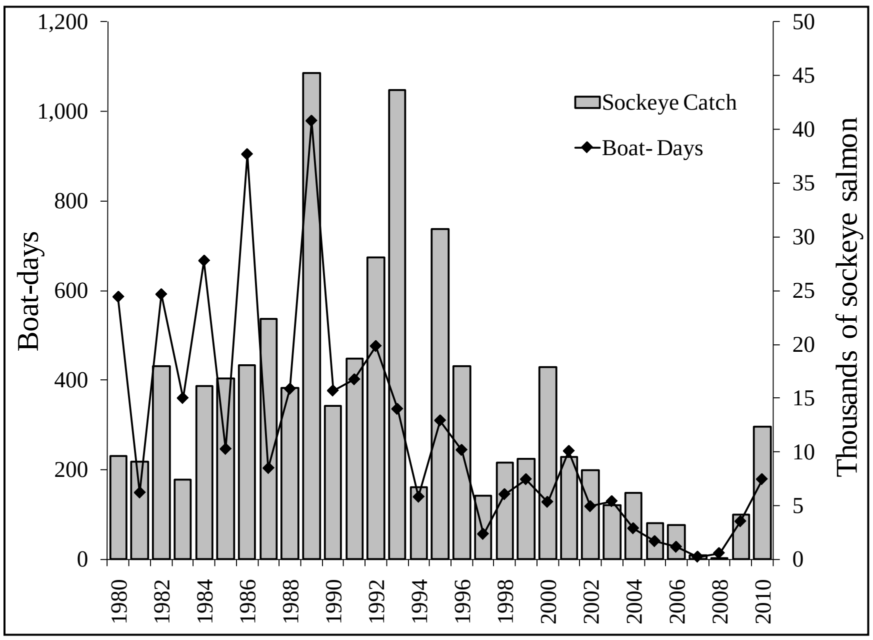

Figure 10.–Fishing effort in boat-days and sockeye salmon catch in the District 101-23 purse seine fishery, 1980–2010.

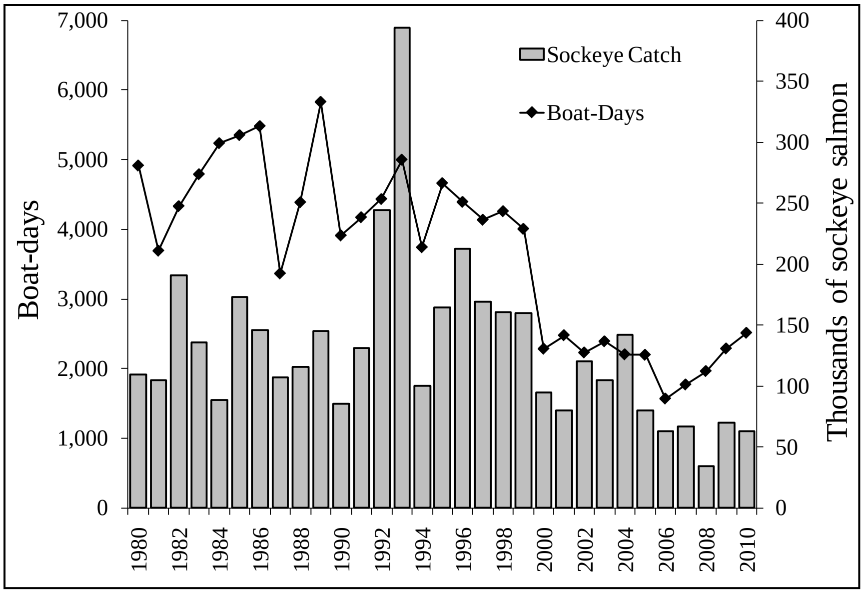

Figure 11.–Fishing effort in boat-days and sockeye salmon catch in the District 101-11 drift gillnet fishery, 1980–2010.

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APPENDICES

The weekly age-sex distribution, the seasonal age-sex distribution weighted by week, and the mean length by age and sex weighted by week, for smolt and adults, were calculated using equations from Cochran (1977; pages 52, 107-108, and 142-144).

Let

h	=	index of the stratum (week),
j	=	index of the age class,
p_{hj}	=	proportion of the sample taken during stratum h that is age j,
n_h	=	number of fish sampled in week h, and
n_{hj}	=	number observed in class j, week h.

Then the age distribution was estimated for each week of the escapement in the usual manner:

$$\hat{p}_{hj} = n_{hj} / n_h \ . \qquad (1)$$

If N_h equals the number of fish in the escapement in week h, standard errors of the weekly age class proportions are calculated in the usual manner (Cochran 1977, page 52, equation 3.12):

$$SE\left(\hat{p}_{hj}\right) = \sqrt{\left[\frac{\left(\hat{p}_{hj}\right)\left(1-\hat{p}_{hj}\right)}{n_h - 1}\right]\left[1 - n_h / N_h\right]} \ . \qquad (2)$$

The age distributions for the total escapement were estimated as a weighted sum (by stratum size) of the weekly proportions. That is,

$$\hat{p}_j = \sum_h p_{hj}\left(N_h / N\right), \qquad (3)$$

such that N equals the total escapement. The standard error of a seasonal proportion is the square root of the weighted sum of the weekly variances (Cochran 1977, pages 107–108):

$$SE\left(\hat{p}_j\right) = \sqrt{\sum_j^h \left[SE\left(\hat{p}_{hj}\right)\right]^2 \left(N_h / N\right)^2} \ . \qquad (4)$$

The mean length, by sex and age class (weighted by week of escapement), and the variance of the weighted mean length, were calculated using the following equations from Cochran (1977, pages 142-144) for estimating means over subpopulations. That is, let i equal the index of the individual fish in the age-sex class j, and y_{hij} equal the length of the ith fish in class j, week h, so that,

$$\hat{\bar{Y}}_j = \frac{\sum_h \left(N_h / n_h\right) \sum_i y_{hij}}{\sum_h \left(N_h / n_h\right) n_{hj}} \text{, and} \qquad (5)$$

$$\hat{V}\left(\hat{\bar{Y}}_j\right) = \frac{1}{\hat{N}_j^2} \sum_h \frac{N_h^2 \left(1 - n_h / N_h\right)}{n_h \left(n_h - 1\right)} \left[\sum_i \left(y_{hij} - \bar{y}_{hj}\right)^2 + n_{hj}\left(1 - \frac{n_{hj}}{n_h}\right)\left(\bar{y}_{hj} - \hat{\bar{Y}}_j\right)^2\right].$$

Appendix B.–Escapement and run timing for Hugh Smith Lake sockeye salmon, 1967–2010.

Year	**1967**	**1968**	**1969**	**1970**	**1971**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**
Weir Count	6,754	1,617	10,357	8,755	22,096	12,714	15,545	57,219	10,429	16,106	12,245	2,312
Total Escapement[a]								57,219	10,429	16,106	12,245	6,968
Wild fish												
Stocked fish												
Weir Mortalities	NA	NA	NA	NA	NA	NA	NA	81	45	134	201	12
Adults used for egg takes	0	0	0	0	0	0	0	0	0	439	798	619
Spawning Escapement[b]	NA	NA	NA	NA	NA	NA	NA	57,138	10,384	15,533	11,246	6,337
Jacks (not included in weir count)												
Starting Date	1-Jun	13-Jun	11-Jun	9-Jun	20-Jun	5-Jun	7-Jun	4-Jun	30-May	1-Jun	1-Jun	17-Jun
Ending Date	3-Sep	21-Aug	14-Aug	1-Sep	22-Aug	4-Oct	8-Sep	27-Nov	30-Nov	26-Nov	11-Nov	29-Oct
Days Elapsed	94	69	64	84	63	121	93	176	184	178	163	134
Date of First Sockeye	13-Jun	14-Jun	11-Jun	11-Jun	20-Jun	6-Jun	8-Jun	7-Jun	1-Jun	6-Jun	5-Jun	18-Jun
Date of Last Sockeye	3-Sep	21-Aug	14-Aug	1-Sep	22-Aug	4-Oct	8-Sep	25-Oct	25-Oct	19-Nov	29-Oct	3-Oct
Days Elapsed for sockeye caught	82	68	64	82	63	120	92	140	146	166	146	107
10th Percentile Run Date	22-Jun	2-Jul	26-Jun	26-Jun	1-Jul	4-Jul	28-Jun	20-Jun	11-Jul	14-Jul	12-Jul	11-Jul
25th Percentile Run Date	28-Jun	11-Jul	9-Jul	6-Jul	9-Jul	20-Jul	7-Jul	29-Jun	17-Jul	26-Jul	25-Jul	15-Jul
50th Percentile Run Date	7-Jul	15-Aug	20-Jul	27-Jul	20-Jul	6-Aug	27-Jul	9-Jul	11-Aug	8-Aug	23-Aug	20-Jul
75th Percentile Run Date	18-Jul	19-Aug	7-Aug	6-Aug	19-Aug	26-Aug	24-Aug	18-Jul	4-Sep	26-Aug	2-Sep	28-Jul
90th Percentile Run Date	28-Jul	21-Aug	9-Aug	13-Aug	20-Aug	9-Sep	3-Sep	7-Aug	24-Sep	10-Sep	13-Sep	8-Aug

[a] The total escapement equals the weir count, 1967–1985. Separate counts of jacks were not kept from 1967 to 1985, so these weir counts include an unknown number of jacks. Escapements are separated into numbers of wild and stocked fish only for years with available otolith data (2003–2007).

[b] The spawning escapement equals the total estimated escapement minus the weir mortalities (coded-wire-tagged fish) and fish killed for egg takes.

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Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Weir Count	33,097	5,056	6,513	1,285	5,885	65,737	11,312	8,386	3,424	7,123	12,182	1,138
Total Escapement[a]	33,097	5,056	6,513	1,285	5,885	65,737	13,532	8,992	3,452	7,123	12,182	1,138
Wild fish												
Stocked fish												
Weir Mortalities	0	28	32	28	33	151	278	42	11	57	28	23
Adults used for egg takes	1,902	424	1,547	0	357	178	1,460	763	312	513	0	218
Spawning Escapement[b]	31,195	4,604	4,934	1,257	5,495	65,408	11,794	8,187	3,129	6,553	12,154	897
Jacks (not included in weir count)												
Starting Date	3-Jun	5-Jun	3-Jun	8-Jun	17-Jun	16-Jun	17-Jun	20-Jun	17-Jun	17-Jun	18-Jun	17-Jun
Ending Date	21-Oct	22-Oct	25-Oct	31-Oct	9-Oct	25-Oct	4-Nov	1-Nov	3-Nov	4-Nov	5-Nov	11-Nov
Days Elapsed	140	139	144	145	114	131	140	134	139	140	140	147
Date of First Sockeye	8-Jun	12-Jun	11-Jun	13-Jun	19-Jun	16-Jun	20-Jun	20-Jun	19-Jun	20-Jun	18-Jun	19-Jun
Date of Last Sockeye	4-Oct	16-Oct	18-Oct	21-Oct	11-Oct	18-Oct	3-Nov	26-Oct	1-Nov	20-Oct	1-Nov	12-Oct
Days Elapsed for sockeye caught	118	126	129	130	114	124	136	128	135	122	136	115
10th Percentile Run Date	18-Jul	19-Jul	30-Jul	8-Jul	22-Jul	12-Jul	2-Jul	20-Jul	7-Jul	25-Jul	3-Jul	8-Jul
25th Percentile Run Date	20-Jul	24-Jul	5-Aug	23-Jul	29-Jul	19-Jul	16-Jul	1-Aug	17-Jul	11-Aug	16-Jul	21-Jul
50th Percentile Run Date	4-Aug	9-Aug	10-Aug	27-Aug	21-Aug	27-Jul	30-Jul	23-Aug	29-Jul	19-Aug	25-Jul	30-Jul
75th Percentile Run Date	30-Aug	25-Aug	14-Aug	7-Sep	12-Sep	29-Jul	14-Aug	26-Aug	9-Aug	3-Sep	2-Aug	10-Aug
90th Percentile Run Date	31-Aug	1-Sep	22-Aug	16-Sep	22-Sep	11-Aug	31-Aug	3-Sep	21-Aug	13-Sep	15-Aug	18-Aug

[a]The total escapement equals the mark-recapture estimate (1986, 1993, 1994, 1995) plus weir mortalities, or the weir count. (Data used to calculate a Petersen estimate in 1986 are not available). Separate counts of jacks were not kept from 1986 to 1997, so these weir counts include an unknown number of jacks. Escapements are separated into numbers of wild and stocked fish only for years with available otolith data (2003–2007).

[b]The spawning escapement equals the total estimated escapement minus the weir mortalities (coded-wire-tagged fish) and fish killed for egg takes.

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Appendix B.–Page 3 of 3.

Year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Weir Count	3,174	4,281	3,665	6,166	19,588	19,930	24,108	42,529	34,077	3,590	9,483	15,646
Total Escapement[a]	3,174	4,281	3,825	6,166	19,588	19,930	24,108	42,529	34,077	3,590	9,483	15,646
Wild fish					6,856	6,976	10,366	14,993	13,713			
Stocked fish					12,732	12,955	13,742	27,537	20,364			
Weir Mortalities	20	12	6	0	20	196	236	417	334	2	0	0
Adults used for egg takes	276	280	268	286	0	0	0	0	0	0	0	0
Spawning Escapement[b]	2,878	3,989	3,551	5,880	19,568	19,734	23,872	42,112	33,743	3,588	9,483	15,646
Jacks (not included in weir count)				167	1,356	147	331	4	236	260	301	158
Starting Date	16-Jun	17-Jun	16-Jun	17-Jun	17-Jun	17-Jun	17-Jun	17-Jun	17-Jun	17-Jun	16-Jun	16-Jun
Ending Date	8-Nov	11-Nov	11-Nov	4-Nov	7-Nov	7-Nov	4-Nov	7-Nov	4-Nov	3-Nov	8-Nov	8-Nov
Days Elapsed	145	147	148	140	146	142	143	143	140	139	145	146
Date of First Sockeye	22-Jun	19-Jun	19-Jun	19-Jun	19-Jun	18-Jun	19-Jun	19-Jun	18-Jun	19-Jun	18-Jun	18-Jun
Date of Last Sockeye	4-Oct	27-Oct	6-Oct	17-Oct	2-Nov	31-Oct	22-Oct	3-Nov	26-Oct	28-Oct	5-Oct	4-Oct
Days Elapsed for sockeye caught	104	130	109	120	136	135	125	137	130	131	110	110
10th Percentile Run Date	7-Jul	29-Jun	2-Jul	10-Jul	2-Aug	8-Jul	17-Jul	1-Aug	19-Jul	16-Jul	4-Jul	5-Jul
25th Percentile Run Date	15-Jul	7-Jul	18-Jul	4-Aug	17-Aug	4-Aug	31-Jul	4-Aug	16-Aug	26-Jul	10-Jul	23-Jul
50th Percentile Run Date	31-Jul	20-Jul	17-Aug	7-Aug	21-Aug	6-Aug	20-Aug	9-Aug	28-Aug	31-Jul	23-Jul	24-Jul
75th Percentile Run Date	15-Aug	30-Jul	22-Aug	9-Aug	28-Aug	29-Aug	26-Aug	15-Aug	1-Sep	14-Aug	11-Aug	29-Jul
90th Percentile Run Date	22-Aug	6-Aug	23-Aug	12-Aug	2-Sep	2-Sep	3-Sep	26-Aug	7-Sep	24-Aug	13-Aug	11-Aug

[a]The total escapement equals the mark-recapture estimate (2001) plus weir mortalities, or the weir count. Separate counts of jacks were not kept from 1998 to 2000, so these weir counts include an unknown number of jacks. Escapements are separated into numbers of wild and stocked fish only for years with available otolith data (2003–2007).

[b]The spawning escapement equals the total estimated escapement minus the weir mortalities (coded-wire-tagged fish) and fish killed for egg takes.

Appendix C.–Mark-recapture estimates for Hugh Smith Lake sockeye salmon, 1992–2010.

Year	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Live Weir Count [a]	**65,586**[b]	11,034	8,344	3,413	**7,066**	**12,154**	**1,115**	**3,154**	**4,269**	3,629
Proportion Marked	36%	99%	97%	100%	99%	67%	67%	67%	67%	50%
Number Marked	23,790	10,973	8,126	3,396	6,995	8,100	745	2,103	2,846	1,807
Number Sampled for Marks	1,974	2,377	1,152	1,028	374	934	226	323	443	484
Number of Marks Recovered	814	2,029	1,041	1,006	369	638	157	221	299	230
Pooled Petersen Estimate[c,d]	57,652	12,854	8,992	3,470	7,090	11,853	1,071	3,070	4,213	**3,789**
se	1,520	99	81	13	41	253	42	109	131	168
+/-95% CI	2,979	194	159	25	80	496	82	214	257	329
CV	3%	1%	1%	0%	1%	2%	4%	4%	3%	4%
ML Darroch Estimate[c]	Failed	**13,254**	Failed	Failed	Failed	12,312	1,015	3,038	4,050	-
se		134				849	46	138	145	
+/-95% CI		263				1,664	90	270	284	
CV		1%				7%	5%	5%	4%	
ML Darroch - Pooled Strata[e]	58,712	-	**8,925**	**3,441**	7,090	-	-	-	-	3,641
se	1,823		77	70	42					205
+/-95% CI	3,573		151	137	82					402
CV	3%		1%	2%	1%					6%

[a] The weir count used for the mark-recapture calculations was the number of live fish (weir count minus weir mortalities) passed through the weir.

[b] Boldfaced estimates were used as the official escapement estimate for that year.

[c] Pooled Petersen, and ML Darroch estimates and their standard errors were calculated using Stratified Population Analysis Software. Release data were stratified into three release periods and recovery data were stratified by recovery days.

[d] Chi-square tests for goodness of fit and complete mixing in 1993, 1994, and 1995 were highly significant and suggest that the ML Darroch estimates should be used rather than a Pooled Petersen estimate.

[e] When ML Darroch estimates failed to converge, data were pooled until an estimate was obtained.

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Appendix C.–Page 2 of 2.

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Live Weir Count [a]	**5,999**[b]	**19,568**	**19,734**	**23,872**	**42,112**	**33,743**	**3,588**	**9,483**	**15,646**
Proportion Marked	50%	10%	10%	10%	10%	10%	10%	10%	10%
Number Marked	2,999	1,945	1,979	2,278	4,208	3,414	358	949	1,565
Number Sampled for Marks	908	2,057	1,547	1,244	2,187	1,764	659	1,271	3,652
Number of Marks Recovered	449	194	136	115	229	176	50	123	339
Pooled Petersen Estimate[c,d]	6,059	20,537	22,372	24,459	40,039	34,053	4,645	9,744	16,824
se	187	1,324	1,754	2,098	2,423	2,357	573	772	768
+/-95% CI	367	2,595	3,438	4,112	4,749	4,621	1,123	1,513	1,505
CV	3%	6%	8%	9%	6%	7%	12%	8%	5%
ML Darroch Estimate[c]	Failed	19,147	21,950						
se		1,526	1,991						
+/-95% CI		2,990	4,000						
CV		8%	9%						
ML Darroch - Pooled Strata[e]	6,047								
se	194								
+/-95% CI	380								
CV	3%								

[a]The weir count used for the mark-recapture calculations was the number of live fish (weir count minus weir mortalities) passed through the weir.

[b]Boldfaced estimates were used as the official escapement estimate for that year.

[c]Pooled Petersen, and ML Darroch estimates and their standard errors were calculated using Stratified Population Analysis Software. Release data were stratified into three release periods and recovery data were stratified by recovery days.

[d]Chi-square tests for goodness of fit and complete mixing in 1993, 1994, and 1995 were highly significant and suggest that the ML Darroch estimates should be used rather than a Pooled Petersen estimate.

[e]When ML Darroch estimates failed to converge, data were pooled until an estimate was obtained.

Appendix D.–Age distribution of the Hugh Smith Lake sockeye salmon escapement, weighted by week, 1980–2010.

Return Year		Age Class																
		0.1	1.1	2.1	3.1	0.2	1.2	2.2	3.2	0.3	1.3	2.3	3.3	1.4	2.4	1.5	2.5	Total
1980	Number by Age Class		37				1,055	113			9,380	2,129						12,714
	SE of Number		0				16	1			150	39						
	Proportion by Age Class		0.3%				8.3%	0.9%			73.8%	16.7%						
	SE of Proportion		0.0%				0.1%	0.0%			1.2%	0.3%						
	Sample Size		3				72	12			719	175						981
1981	Number by Age Class		250				7,216	1,826			4,598	1,655						15,545
	SE of Number		1				114	32			65	30						
	Proportion by Age Class		1.6%				46.4%	11.7%			29.6%	10.6%						
	SE of Proportion		0.0%				0.7%	0.2%			0.4%	0.2%						
	Sample Size		19				502	149			338	137						1,145
1982	Number by Age Class						1,613	805		12	52,124	2,665						57,219
	SE of Number						17	7		0	183	44						
	Proportion by Age Class						2.8%	1.4%		0.0%	91.1%	4.7%						
	SE of Proportion						0.0%	0.0%		0.0%	0.3%	0.1%						
	Sample Size						174	122		1	2,305	407						3,009
1983	Number by Age Class		14	8			1,375	495		12	5,501	2,843		182				10,429
	SE of Number		0	0			20	6		0	103	44		2				
	Proportion by Age Class		0.1%	0.1%			13.2%	4.7%		0.1%	52.7%	27.3%		1.7%				
	SE of Proportion		0.0%	0.0%			0.2%	0.1%		0.0%	1.0%	0.4%		0.0%				
	Sample Size		1	1			157	57		2	565	301		23				1,107
1984	Number by Age Class		9				966	551			10,436	4,144						16,106
	SE of Number		0				14	6			95	72						
	Proportion by Age Class		0.1%				6.0%	3.4%			64.8%	25.7%						
	SE of Proportion		0.0%				0.1%	0.0%			0.6%	0.4%						
	Sample Size		1				149	56			1,007	378						1,591
1985	Number by Age Class			15			76	43			8,935	2,997	13	74	70		23	12,245
	SE of Number			0			1	0			104	55	0	1	0		0	
	Proportion by Age Class			0.1%			0.6%	0.3%			73.0%	24.5%	0.1%	0.6%	0.6%		0.2%	
	SE of Proportion			0.0%			0.0%	0.0%			0.9%	0.4%	0.0%	0.0%	0.0%		0.0%	
	Sample Size			1			10	6			856	279	2	6	7		3	1,170
1986	Number by Age Class		5			4	5,076	780			745	305		49		5		6,968
	SE of Number		0			0	20	11			4	3		0		0		
	Proportion by Age Class		0.1%			0.1%	72.8%	11.2%			10.7%	4.4%		0.7%		0.1%		
	SE of Proportion		0.0%			0.0%	0.3%	0.2%			0.1%	0.0%		0.0%		0.0%		
	Sample Size		1			1	1,389	191			195	77		13		1		1,868

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Return Year		Age Class																
		0.1	1.1	2.1	3.1	0.2	1.2	2.2	3.2	0.3	1.3	2.3	3.3	1.4	2.4	1.5	2.5	Total
1987	Number by Age Class		147	130			626	1,030	24		29,329	1,733	61	17				33,097
	SE of Number		1	1			2	6	0		221	27	0	0				
	Proportion by Age Class		0.4%	0.4%			1.9%	3.1%	0.1%		88.6%	5.2%	0.2%	0.1%				
	SE of Proportion		0.0%	0.0%			0.0%	0.0%	0.0%		0.7%	0.1%	0.0%	0.0%				
	Sample Size		9	18			66	132	4		3,374	278	6	1				3,888
1988	Number by Age Class		5	3			1,907	1,237			1,054	782	2	67				5,056
	SE of Number		0	0			13	9			6	4	0	0				
	Proportion by Age Class		0.1%	0.1%			37.7%	24.5%			20.8%	15.5%	0.0%	1.3%				
	SE of Proportion		0.0%	0.0%			0.3%	0.2%			0.1%	0.1%	0.0%	0.0%				
	Sample Size		3	2			1,076	727			624	499	1	46				2,978
1989	Number by Age Class						163	52	1		5,808	486	1		2			6,513
	SE of Number						1	1	0		32	7	0		0			
	Proportion by Age Class						2.5%	0.8%	0.0%		89.2%	7.5%	0.0%		0.0%			
	SE of Proportion						0.0%	0.0%	0.0%		0.5%	0.1%	0.0%		0.0%			
	Sample Size						116	24	1		1,489	184	1		1			1,816
1990	Number by Age Class		12	1			52	38			658	495	1	27				1,285
	SE of Number		0	0			0	0			5	9	0	0				
	Proportion by Age Class		0.9%	0.1%			4.1%	3.0%			51.2%	38.5%	0.1%	2.1%				
	SE of Proportion		0.0%	0.0%			0.0%	0.0%			0.4%	0.7%	0.0%	0.0%				
	Sample Size		8	1			39	29			537	294	1	24				933
1991	Number by Age Class		2	26	4		1,588	2,028	2		781	1,442			13			5,885
	SE of Number		0	0	0		7	20	0		2	8			0			
	Proportion by Age Class		0.0%	0.4%	0.1%		27.0%	34.5%	0.0%		13.3%	24.5%			0.2%			
	SE of Proportion		0.0%	0.0%	0.0%		0.1%	0.3%	0.0%		0.0%	0.1%			0.0%			
	Sample Size		2	11	1		1,274	1,103	1		629	998			8			4,027
1992	Number by Age Class		3	3			1,587	1,262	15		60,690	1,824		336	15			65,737
	SE of Number		0	0			22	31	0		589	34		2	0			
	Proportion by Age Class		0.0%	0.0%			2.4%	1.9%	0.0%		92.3%	2.8%		0.5%	0.0%			
	SE of Proportion		0.0%	0.0%			0.0%	0.0%	0.0%		0.9%	0.1%		0.0%	0.0%			
	Sample Size		1	1			63	105	1		914	135		2	2			1,224
1993	Number by Age Class			13			1,137	1,916	10		3,055	7,038	66	285	13			13,532
	SE of Number			0			25	39	0		50	135	1	5	0			
	Proportion by Age Class			0.1%			8.4%	14.2%	0.1%		22.6%	52.0%	0.5%	2.1%	0.1%			
	SE of Proportion			0.0%			0.2%	0.3%	0.0%		0.4%	1.0%	0.0%	0.0%	0.0%			
	Sample Size			2			62	163	1		279	564	2	31	1			1,105

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Appendix D.–Page 3 of 5.

Return Year		Age Class 0.1	1.1	2.1	3.1	0.2	1.2	2.2	3.2	0.3	1.3	2.3	3.3	1.4	2.4	1.5	2.5	Total
1994	Number by Age Class		51	41			572	625	6		6,546	1,079		66	5	2		8,992
	SE of Number		0	0			5	7	0		106	11		0	0	0		
	Proportion by Age Class		0.6%	0.5%			6.4%	7.0%	0.1%		72.8%	12.0%		0.7%	0.1%	0.0%		
	SE of Proportion		0.0%	0.0%			0.1%	0.1%	0.0%		1.2%	0.1%		0.0%	0.0%	0.0%		
	Sample Size		12	13			148	91	2		966	243		18	2	1		1,496
1995	Number by Age Class			25			902	451			802	1,226		44	1			3,452
	SE of Number			0			14	6			13	24		0	0			
	Proportion by Age Class			0.7%			26.1%	13.1%			23.2%	35.5%		1.3%	0.0%			
	SE of Proportion			0.0%			0.4%	0.2%			0.4%	0.7%		0.0%	0.0%			
	Sample Size			16			299	133			263	408		13	1			1,133
1996	Number by Age Class		12				1,012	1,654	6		3,519	904			16			7,123
	SE of Number		0				30	79	0		93	24			1			
	Proportion by Age Class		0.2%				14.2%	23.2%	0.1%		49.4%	12.7%			0.2%			
	SE of Proportion		0.0%				0.4%	1.1%	0.0%		1.3%	0.3%			0.0%			
	Sample Size		2				97	76	1		287	70			1			534
1997	Number by Age Class		18				249	403			10,791	664	20	35				12,180
	SE of Number		0				5	4			121	20	0	0				
	Proportion by Age Class		0.1%				2.0%	3.3%			88.6%	5.5%	0.2%	0.3%				
	SE of Proportion		0.0%				0.0%	0.0%			1.0%	0.2%	0.0%	0.0%				
	Sample Size		1				13	22			580	37	1	2				656
1998	Number by Age Class		27	9		3	75	49			576	332		66				1,138
	SE of Number		4	1		0	4	2			26	21		4				
	Proportion by Age Class		2.4%	0.8%		0.3%	6.6%	4.3%			50.6%	29.2%		5.8%				
	SE of Proportion		0.3%	0.1%		0.0%	0.3%	0.2%			2.3%	1.9%		0.3%				
	Sample Size		2	3		1	9	7			81	32		5				140
1999	Number by Age Class			29			1,658	538			573	363		6	7			3,174
	SE of Number			1			35	11			13	7		0	0			
	Proportion by Age Class			0.9%			52.2%	17.0%			18.1%	11.4%		0.2%	0.2%			
	SE of Proportion			0.0%			1.1%	0.3%			0.4%	0.2%		0.0%	0.0%			
	Sample Size			4			245	77			81	53		1	1			462

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Appendix D.–Page 4 of 5.

Return Year		Age Class																
		0.1	**1.1**	**2.1**	**3.1**	**0.2**	**1.2**	**2.2**	**3.2**	**0.3**	**1.3**	**2.3**	**3.3**	**1.4**	**2.4**	**1.5**	**2.5**	**Total**
2000	Number by Age Class		14		13		918	302			2,251	769	14					4,281
	SE of Number		0		0		21	5			52	22	0					
	Proportion by Age Class		0.3%		0.3%		21.4%	7.1%			52.6%	18.0%	0.3%					
	SE of Proportion		0.0%		0.0%		0.5%	0.1%			1.2%	0.5%	0.0%					
	Sample Size		1		1		94	33			257	70	1					457
2001	Number by Age Class	7	60			6	162	71			2,908	598		7	6			3,825
	SE of Number	0	1			0	13	1			43	9		0	0			
	Proportion by Age Class	0.2%	1.6%			0.2%	4.2%	1.9%			76.0%	15.6%		0.2%	0.2%			
	SE of Proportion	0.0%	0.0%			0.0%	0.3%	0.0%			1.1%	0.2%		0.0%	0.0%			
	Sample Size	1	9			1	25	14			591	120		1	1			763
2002	Number by Age Class		6	21			3,981	564			1,318	263		13				6,166
	SE of Number		0	1			58	11			21	6		0				
	Proportion by Age Class		0.1%	0.3%			64.6%	9.2%			21.4%	4.3%		0.2%				
	SE of Proportion		0.0%	0.0%			0.9%	0.2%			0.3%	0.1%		0.0%				
	Sample Size		1	3			582	77			197	36		2				898
2003	Number by Age Class		42	67		14	10,028	840	18	136	7,385	1,059						19,588
	SE of Number		2	3		0	144	24	0	0	112	8						
	Proportion by Age Class		0.2%	0.3%		0.1%	51.2%	4.3%	0.1%	0.7%	37.7%	5.4%						
	SE of Proportion		0.0%	0.0%		0.0%	0.7%	0.1%	0.0%	0.0%	0.6%	0.0%						
	Sample Size		3	5		1	622	50	1	9	437	65						1,193
2004	Number by Age Class		523	36			8,623	1,695			8,362	690						19,930
	SE of Number		9	1			154	28			145	6						
	Proportion by Age Class		2.6%	0.2%			43.3%	8.5%			42.0%	3.5%						
	SE of Proportion		0.0%	0.0%			0.8%	0.1%			0.7%	0.0%						
	Sample Size		25	2			385	84			387	39						922
2005	Number by Age Class			26			6,696	1,566		18	14,264	1,537						24,108
	SE of Number			0			86	16		0	176	14						
	Proportion by Age Class			0			27.8%	6.5%		0.1%	59.2%	6.4%						
	SE of Proportion			0			0.3%	0.1%		0.0%	0.7%	0.1%						
	Sample Size			2			440	98		1	900	97						1,538
2006	Number by Age Class						20,815	3,467			16,642	1,604						42,529
	SE of Number						572	83			380	45						
	Proportion by Age Class						48.9%	8.2%			39.1%	3.8%						
	SE of Proportion						1.3%	0.2%			0.9%	0.1%						
	Sample Size						314	102			357	46						819

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Appendix D.–Page 5 of 5.

Return Year		Age Class																
		0.1	1.1	2.1	3.1	0.2	1.2	2.2	3.2	0.3	1.3	2.3	3.3	1.4	2.4	1.5	2.5	Total
2007	Number by Age Class						2,266	592			25,915	5,304						34,077
	SE of Number						39	9			486	109						
	Proportion by Age Class						6.6%	1.7%			76.0%	15.6%						
	SE of Proportion						0.1%	0.0%			1.4%	0.3%						
	Sample Size						34	11			494	96						635
2008	Number by Age Class						1,437	855			708	445		129	16			3,590
	SE of Number						40	19			21	12		2	2			
	Proportion by Age Class						40.0%	23.8%			19.7%	12.4%		3.6%	0.4%			
	SE of Proportion						1.1%	0.5%			0.6%	0.3%		0.1%	0.0%			
	Sample Size						140	90			67	44		13	1			355
2009	Number by Age Class						2,407	1,588			4,397	1,091						9,483
	SE of Number						40	135			80	18						
	Proportion by Age Class						25.4%	16.7%			46.4%	11.5%						
	SE of Proportion						0.4%	0.4%			0.8%	0.2%						
	Sample Size						186	106			342	75						709
2010	Number by Age Class						3,020	2,762	17		7,987	1,728	120	12				15,646
	SE of Number						44	53	0		129	18	3	0				
	Proportion by Age Class						19.3%	17.7%	0.1%		51.0%	11.0%	0.8%	0.1%				
	SE of Proportion						0.3%	0.4%	0.0%		0.8%	0.1%	0.0%	0.0%				
	Sample Size						184	144	1		499	107	6	1				942